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54 Coaxial High Frequency Plug Connector for Multiple Coaxial lines.

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Description:

The invention is about a coaxial high frequency connector for a connection of numerous coaxial lines with the characteristics of the type described in the terms of patent claim 1 or 2.

Coaxial connector plugs for high frequency technology are already known.
Coaxial connector plugs for the connecting of multiple coaxial lines are needed as an example for transmission technology. There signals speeds for coaxial lines in the high frequency range up to 93% of the speed of light are achieved. Furthermore it is a requirement to prevent as much as possible crosstalk between neighboring lines. Until now in the case of next to one another positioned coaxial lines a lower roster distance between individual lines of 2.54 mm have been achieved in the case of connector plugs. Thereby until now all signal lines and corresponding ground lines were connected manually. As connecting technology conventional soldering is used. Due to the close proximity of signal and ground lines short circuits can easily happen and with that a faulty connection structure. By a separation of signal lines from the ground lines for the junction on the next to one another positioned contacts locations also the coaxial shielding effects of the coaxial lines can be disturbed and /or interrupted. The positioning of next to one another placed signal and ground lines of the numerous always next to one another positioned coaxial lines to the contact locations of the plug lines to additional errors at the time of contact, in the case when signal lines and ground lines are not in full contact with the contact position, as this as an example again and again the case with high frequency coaxial lines, whose signal and ground lines are made of thin wire and lace, which have elastic properties. Such sources of errors have to be removed by appropriate control and by a time-consuming repair procedure. With respect to today's ever progressing miniaturization of components, as an example integrated circuits, which contain an ever growing packing density of functions in the same space, the pressure increases to accommodate an ever greater number of connections for the transmitting of signals of components into a smaller space. For the described case of coaxial lines that would mean, that more and more coaxial lines need to be lead to the connector. The plug connections up until now will be connected to the signal and ground lines using soldering technology in manual fashion and are not formed in such a fashion that an automatic or mechanical connecting of those lines would be possible.
From the print of DE – 0S 2, 018, 376 a coaxial plug connector for a distributor board, terminal board is known. This known plug connection has several connecting positions next to one another, which can be selectively plugged into coaxial plugs. The outside line connections of the connecting positions are formed by the walls of empty spaces of a on the terminal board positioned grid like frame, where the empty spaces formed by the

lattice surrounding the connecting positions of the inside lines and are at least electrically conductive on one side of the wall. These conductive sides of the wall are at least partially connected to one another and connected to a supply potential, and in the empty spaces and/or on the coaxial plugs coiling contact element are provided for the creation of a conducting path between the outside lines of the coaxial plug and the conducting outside wall. The invention has the objective to create a simple and inexpensive, suitable for mass production of a high frequency plug connector used for the connection of several coaxial lines, which especially allows automatic and mechanical connecting of numerous coaxial lines and which allows the achieving of the narrowest raster distance for the connecting of coaxial lines to the singular plugs while maintaining the coaxial shielding effect of each coaxial line for each particular signal line.

This objective will be solved according to the invention by the listed characteristics in the featured parts of patent claim 1 and 2. Advantageous further developments of the invented objects are featured in the characteristics of sub claims 3 to 10.

The advantages of the invention are specially such, that a common intermediate carrier is provided for the base housing. The base housings serve to be the connection for the provided number of individual coaxial lines to the high frequency plug connector. In the first example the meander like, in a row running and electrically conductive intermediate carrier forms together with the it surrounding electrically conductive housing recesses, into which the base housings for the individual coaxial lines can be inserted. These recesses are designed to be high frequency resistant by that, that means the of electrically insulating material made based housing used for leading signal lines are surrounded with a complete electrical shield for each individual coaxial line, which secures impeccable coaxial behavior. The described recesses can be assigned very close to one another, when this happens as an example in a continuous row or in a line like continuing block having openings for the base housings. In such fashion one can achieve up until now not possible close roster distances between signal lines of individual coaxial lines. Roster distances of 2.54 mm distance between two signal lines known from the state of the art can be reduced by at least half.

The lines of thin wires made coaxial lines, like the ones, as an example found used in round cables, in the state of the art will often line to positioning errors at their contact locations due to their elasticity and the coiling properties. In order to enable automatic and mechanical connecting of numerous coaxial lines next to one another while preventing such positioning errors, in the case of the invented object centrally located clearance holes are provided for the signal lines, where for each clearance hole an inlet phase in the form of a cone like expansion of the clearance hole is placed. This cone shaped expansion always provides guidance for the signal lines. This bore with a cone shaped expansion also enables to position springy and lightly elastic signal lines properly at their connecting position, when they are being inserted by mechanical means into this inlet phase. In the case of automatic processing using a handling device due to this cone shaped expansion a passive balance of tolerance is happening, which can also equalize inaccuracies in positioning.

The multiple coaxial plug connectors also do have the characteristics, to be able to connect bundled ground shielding lines or possibly co lines also at the same time in automatic and mechanical fashion for each of the next to one another positioned coaxial lines. For this purpose the coaxial high frequency connector is equipped with a for each individual ground contact of the numerous coaxial lines with a flexible strap on the main housing per ground line. The appropriately bent and supplied individual ground lines of the numerous coaxial lines will fit themselves during the insertion of the already connected to the base housing signal contact in automatic fashion to the suitably formed straps of the main housing wall. Since the supplied individual coaxial lines are supplied with a suitable but here not further described device in rigid fashion in the foreseen raster distance, the pre bent ground lines of the individual coaxial lines are laying themselves exactly onto the pre bent straps of the main housing wall and can be connected by electrical means using suitable soldering devices. Especially the combination compilation and connection of the described characteristics, namely the common intermediate carrier, the provision of a main housing for each individual coaxial line, the shielding effect of the recess for high frequency on the intermediate carrier for the main housing and the automatic connecting possibility for the signal lines and the ground lines of the next to another positioned coaxial lines do enable first the solution of the mandated objective for this coaxial high frequency plug connector according to this invention.

In the following the invention will be explained in more detail using examples and drawings. Shown is:

Fig. 1 A first example of the coaxial high frequency plug connector with a meander like formed intermediate carrier in a cross section view.

Fig. 2 The intermediate carrier according to Fig. 1 shown by itself in a cross section view.

Fig. 3, 4, 5 and 6 the building up and the process of connecting in four steps for the invented coaxial high frequency plug connector with a first main housing, which has an inlet phase for the signal line, each in a cross sectional view, Fig. 3: Phase I, Fig. 4: phase II, Fig. 5: phase III, Fig. 6: phase IV.

Fig. 7 A second example of the invented coaxial high frequency plug connector in a cross sectional view with an intermediate carrier as a closed, row like block,

Fig. 8, 9, and 10 a second main housing for the coaxial high frequency plug connector with an empty isolating shell and the belonging connecting process in three steps. Fig. 8: phase I, Fig. 9: phase II, Fig.10: phase III

In figure 1 a cross sectional view of the first example of a coaxial high frequency plug connector is shown. The high frequency plug connector consist of a main housing 1, which encloses the first base housing 2 of the coaxial high frequency lines in fig. 1 only a signal line 3 is recognizable in a cross sectional view, which is connected with a signal contact 4 for the signal line 3 of the coaxial line 11 is designed to be centered in the first base housing. The in fig. 1 shown coaxial high frequency plug connector has there five

base housings for each of the five individual coaxial lines 11. Depending on the demands of the design the high frequency plug connector can be optionally expanded for additional single lines and also base housing.

The first base housing 2 is with the use of a common first intermediate carrier positioned in an electrically conductive main housing 1. The also of an electrically conductive material made first intermediate carrier, as an example made of a metal or any other electrical material, which would have shielding properties, is formed to be meander like and continuing in a row, look at fig. 2. The meander form of the first intermediate carrier 5 is bent in such fashion, that each time recesses are made in a form, that the first base housing 2 can be stored there. The by the meander like former first intermediate carrier former recess 6 are parallel next to one another. The storing of the first base housing 2 in the first intermediate carrier 5 happens on one hand in the recesses 6, which cover three sides of the base housing and the forth side by the inside of the main housing 1. Since the first intermediate carrier and the main housing is made of electrically conductive material and are in electrical contact with one another, it is resulting, that recesses 6 on all four sides are shielded against high frequency. The first base housing 2 are formed such, that they are stored/positioned in replaceable fashion by the meander like intermediate carrier formed recesses and the particular main housing wall.

In fig. 1 five first base housings are shown. However based on the design demands any number of additional coaxial lines and first base housings in row like fashion and Meade like first intermediate carriers can be designed. Such coaxial high frequency plug connectors are needed for numerous single coaxial as an example by miniaturizing of inserts, such as integrated circuits and with that the greatly increased number of signals to be transmitted. The numerous single coaxial lines are put together as a multi cored round cables, such that then appropriate plugs are necessary, where the manual connection of the lines is rather time consuming and expensive. The electrically conductive main housing 1serves at the same time as a common ground for all for all ground contacts 7 of the to be connected numerous coaxial lines.
For this purpose the main housing 1 is electrically connected for the total number of the to be connected single coaxial lines over one of each ground contacts 7 with the particular ground line 8 of the individual coaxial lines 11. These ground contacts 7 of the main housing consist of bendable brackets, see figure 3 to 6 for this. These ground contacts 7 in the form of bending brackets can be explained as an example directly by punching the main housing 1.
On figure 7 a second example of a shared second intermediate carrier 9 for the second base housing 20 of the coaxial plug connection is visible. Also in this case an electrically conductive housing is provided, which surrounds the second intermediate carrier 9.
But the second intermediate carrier 9 itself is also made of a conductive material. The second intermediate carrier 9 is made as a closed line like block having parallel positioned openings 10. The openings 10 are positioned in the form and size of the base housing 20, is able to slide in the closed line like made block. Openings 10 are again formed being parallel to one another, such that all the second base housing 20 can be inserted at the same time automatically and mechanically into the intermediate carrier 9. The later in more detail described second base housings 20 do have a centrally located

signal contact 4. The second base housings 20 are made of a suitable electrically insulating material and the second intermediate carrier 9 decrees for all the to be connected coaxial lines fore each a ground contact 7 in the form of a bending strap. These straps can be punched out directly from the wall of the intermediate carrier 9.
In the case of the first example according to Fig. 1 as well as the second example according to Fig. 7, formed as strap, are bent in a 90-degree angle from housing wall respectively the wall of the second intermediate carrier 9. With the appropriate 90 degrees bending angle ground lines 8 of the individual coaxial lines are bent. All ground lines 8 of the individual coaxial lines 11 inserted into the first and second intermediate carrier 5 and 9 into the main housing 1, parallel to the as straps formed ground contacts 7 of the main housing 1 and the intermediate carrier 9.
In the following now the first and second example of a first and second base housing 2 and 20 and the with it connecting of the individual coaxial lines on the invented coaxial high frequency connector will be explained.

The numerous individual coaxial lines 11 are provided here in a not shown fashion as an example by a work piece carrier having the necessary roster distance needed for the plug at the same time. The individual coaxial lines are attached in rigid fashion to the fork piece carrier. This enables also feeding of the signal lines as well as the ground lines of the individual coaxial lines in a well-defined angle to the base housing 2 and 20 of the high frequency plug connector. The first example of the base housing 2 is shown in figure 3, 4, 5 and 6.
For the sake of clarity only one single coaxial line 11 is shown. In reality only one single coaxial line 11 is shown. In reality the assembly of the numerous, laying next to one another in a row, single coaxial lines to the base housing 2 happens at the same time.

The coaxial lines 11 are prepared next to one another in roster distance also thereby, that signal line 3 is insulated in the necessary length for signal contact 4 of the first base housing 2. Further more also the ground lines 8 of the coaxial lines 11 are already preassembled. These ground lines can be twisted together from the shielding 19 of the coaxial lines. During the use of coaxial lines with one or two ground lines, whereby these ground lines are connected over the whole length of the coaxial lines with a shielding braid, this ground lines are appropriately cut and bent in a 90^{o} angle to the signal line 3. During the use of two ground lines it is sufficient, to cut one ground line, and only to use one for the connection to the ground on the coaxial cable of the coaxial high frequency plug connector.
The dielectric between the signal lines and the ground lines of the coaxial line, as an example in the form of a plastic insulation 14, protrudes so far beyond the bend away from the coaxial lines 11, ground lines, as the depth of a on the base housing 2 provided inlet phase 12 is formed. This inlet phase 12 is a funnel like enlargement of the transition hole 13 of the base housing 2. The funnel like enlargement on all first base housings 2 are in front of the transition holes 13 such, that all signal lines 3 of the coaxial lines 11 at the time of lining them to the first base housing 2, first will get to the funnel like enlargement of the inlet phase 12, with that it will be possible to use also thin wires as signal lines 3, which can be bent easily in resilient as well also through the insulating material of the dielectric.

By the introduction of the combination characteristic of the inlet phase in the form of a funnel like enlargement during the connecting, meaning the feeding of the signal lines 11 into the first base housing 2, all also slightly spatially displaced signal lines are brought the tolerance of the inlet phase 12 and the signal lines 3 are in secure fashion inserted into the transition holes 13 of the first housing 2, such that contact can be made between the signal lines 3 and the signal contacts 4 of the first base housing 2, see figure 4.The plastic insulating 4, which reaches beyond the bent ground lines 8 of the coaxial cables, which is designed to be elastic, as an example a plastic material , will be during the insertion of coaxial line 11 into the base housing 2 pressed into a funnel like enlargement of the inlet phase 12. By that the elastic insulation 14 will be formed appropriately to the form of the funnel like enlargement of the inlet phase 12 and is under pressure and close to the wall of the these funnel like enlargements. Now the under line and/or the signal lines 3 of the coaxial lines 11 will be connected electrically with the signal contacts 4 of the first base housing 2. For this any suited process from the state of the art can be utilized.

After the connecting of signal lines 3 with the signal contact 4 the first base housings will all be inserted automatically or mechanically into the main housing wall 1, look at figure 5. When the base housing is fully inserted into the main housing 1, then the at a 90^{o} from the coaxial lines 11 bent ground lines 8 and also the at 90^{o} from the main housing 1 bent ground contacts 7 of the main housing are parallel to one another. Now the ground contacts 7 of the main housing 1 and the grounds lines 8, coaxial lines 1 will be in an electrically suitable way connected by soldering, welding or any other suitable form.

Now in a forth step the electrically connected ground contacts of the main housing and the ground lines of the coaxial lines 11 will be bent back mechanically into the plain of the main housing. The invented coaxial high frequency plug connector is with that finished (completed). The completed high frequency plug connector can be electively connected to a receptacle connector, as shown in figures 3 to 6, but especially Fig. 6. The receptacle connector 15 has again signal contacts 16 and the ground contacts 17. Of course the invented coaxial high frequency plug connector can also be connected to a suitable male connector, which is not shown. The ground pick up of the ground lines and ground co lines of all individual coaxial lines happens here over the main housing 1.

A further example of the base housing in a second embodiment can be seen in fig. 8, 9 and 10. Here also individual coaxial lines 11 in the for the high frequency plug connector necessary roster distance will be forcible actuated as an example on a not shown work piece carrier positioned opposite of the plug connector into position. For purpose of clarity here only one coaxial line 11 and only a second base housing 20 is shown. During an actual connecting process again all individual second base housing 20 the appropriate opposing coaxial lines 11 are inserted at the same time. The individual coaxial lines 11 have over an angle of 90^{o} over the length of the coaxial line bent away ground lines, which can consist of twisted together shielding of the coaxial lines or of the appropriate bent ground lines of coaxial lines. The centerline and/or the signal line 3 of the coaxial lines 11 again are without insulation in the appropriate length appropriate for the circumstances of the main housing 1. The second base housing 20 is here partially

inserted able into the second intermediate carrier 9. The second base housing 20 centrally positioned signal contact 4 is positioned in insert able fashion in the second base housing 2.

The connection of the individual coaxial lines 11 to the coaxial high frequency plug connector will be described in the following. The signal lines 3 of coaxial lines 11 are positioned opposite of the signal contact 4 of the second base housing 20. By the suitable form of the tip 18 of signal contact 4, as an example also a funnel like form, it will be ensured, that signal lines 3 will be positioned in signal contacts 4. Now the signal lines 3 and signal contacts4 arte connected electrically, which can happen as example by soldering or any other suitable form, that can provide an impeccable electrical connection. During the next step signal contacts 4 as well as also the base housing 20 will be fully inserted in the intermediate carrier 9.
After this has happened, all the 90^{o} bent away ground lines 8 of the coaxial lines 11 and also the 90 bent straps and/or ground contacts 7 of the main housing are parallel to one another. Now the ground contacts 7 of the main housing1 and the ground lines 8 of the coaxial lines 11 are connected to another, which can again happen by welding or any other suited electrical connection. With that again common ground pick up of all ground lines of the coaxial lines is possible over the main housing 1. Immediately following the ground straps are bent in such a way, that they are again in the plain of the main housing.

The total number of coaxial lines 11, which are connected to the invented coaxial high frequency plug connector in a main housing 1, can be raised by the fact, that several main housings 1 can be assembled above one another or next to one another to an even larger connecting plug connector.

Reference list:

1) Main housing
2) First base housing
3) Signal lines
4) Signal contacts
5) First intermediate carrier
6) Recess
7) Ground contact of main housing
8) Ground lines of coaxial lines
9) Second intermediate carrier
10) Openings
11) Coaxial lines
12) Inlet phase
13) Transition opening
14) Elastic insulation
15) Female plug
16) Signal contacts of female plug
17) Ground contact of female plug
18) Tip of signal contact

19) Shielding
20) Second base housing.

Claims

1. A coaxial high-frequency plug-type connector comprising multiple coaxial lines (11),

a) in which the connector terminals of the coaxial lines (11) are disposed directly adjacent each other in a row and are enclosed by a common housing,
b) with the electrical contacts of the signal and ground lines for the individual coaxial lines (11) coming to lie directly adjacent each other and the signal contacts (4) being electrically isolated from each other,
c) with a common first intermediate support (5) made of electrically conductive material being provided for base housings (2, 20) for terminating multiple individual coaxial lines (11), and
d) with the base housings (2, 20) having a signal contact (4) disposed centrally therein, and consisting of electrically insulating material,

characterized in

e) that the first intermediate support (5) is enclosed by an electrically conductive overall housing (1),
f) that the first intermediate support is in the form of a meandering continuous line,
g) that the base housings (2, 20) for termination of the individual coaxial lines (11) are disposed on the one hand between recesses (6), constituted by the meandering first intermediate support (5) and disposed parallel beside each other, and an overall housing wall each on the other hand,
h) that the base housings (2, 20) are slidably supported in the recesses (6) of the first intermediate support (5) and the overall housing wall,
i) that the overall housing (1) has, for the total number of the individual coaxial lines (11) to be terminated, one ground contact (7) each which are provided in the form of bendable lugs disposed on the overall housing wall, and in
j) that both the ground lines (8) of the coaxial lines (11) and the ground contacts (7) of the overall housing (1) are bent off at an angle for electrical connection thereof.

2. A coaxial high-frequency plug-type connector comprising multiple coaxial lines (11),

a) in which the connector terminals of the coaxial lines (11) are disposed directly adjacent each other in a row and are enclosed by a common housing,
b) with the electrical contacts of the signal and ground lines for the individual coaxial lines (11) coming to lie directly adjacent each other and the signal contacts (4) being electrically isolated from each other,
c) with a common second intermediate support (9) made of electrically conductive material being provided for base housings (2, 20) for terminating multiple individual coaxial lines (11),
d) with the second intermediate support (9) being provided in the form of a closed block extending in the form of a continuous line and having openings (10) arranged beside each other in parallel manner,
e) with the base housings (2, 20) for terminating the individual coaxial lines (11) being disposed in these openings,
f) with the base housings (2, 20) being slidably supported in the openings (10) of the second intermediate

support (9), and
g) with the base housings (2, 20) each having a signal contact (4) disposed centrally therein, and consisting of electrically insulating material,

characterized in

h) that the second intermediate support (9) is enclosed by an electrically conductive overall housing (1),
i) that the second intermediate support (9) has, for the total number of the individual coaxial lines (11) to be terminated, one ground contact (7) each which are provided in the form of bendable lugs disposed on the intermediate support wall, and in
j) that both the ground lines (8) of the coaxial lines (11) and the ground contacts (7) of the second intermediate support (9) are bent off at an angle for electrical connection thereof.

3. A coaxial high-frequency plug-type connector according to claim 1 or 2, characterized in that all ground lines (8) of the coaxial lines (11) of the base housings (2, 20) introduced into the first or second intermediate support (5 or 9, respectively) and connected to the signal contacts (4), upon introduction of the first or second intermediate support (5 or 9, respectively) into the overall housing (1), abut the ground contacts (7) of the overall housing (1) in parallel manner.

4. A coaxial high-frequency plug-type connector according to one or several of claims 1 or 2 and 3, characterized in

a) that a first base housing (2) has a centrally disposed through-hole (13) for the signal line (3) of the coaxial lines (11), and in
b) that in front of the through-hole (13), there is provided an introduction taper (12) in the form of a funnel-shaped expansion of the through hole (13) for the signal line (3), said introduction taper opening in the feed direction of the coaxial lines.

5. A coaxial high-frequency plug-type connector according to one or several of the claims 1 or 2, 3 and 4, characterized in that the insulation (14) of the signal line (3), at the time of attachment of the signal line (3) to the signal contact (4), is introduced into the introduction taper (12) of the base housing (2) and abuts there under pressure.

6. A coaxial high-frequency plug-type connector according to one or several of the claims 1 or 2, 3, characterized in that a second base housing (20) consists of a hollow insulating material sleeve in which the centrally disposed signal contact (4) is arranged.

7. A coaxial high-frequency plug-type connector according to one or several of the claims 1 or 2, or 3 to 6, characterized in that the centrally disposed signal contact (4) is slidably supported in the insulating material sleeve.

8. A coaxial high-frequency plug-type connector according to one or several of the claims 1 or 2 or 3 to 7, characterized in that the bending angle of the ground lines (8) from the coaxial lines (11) and of the ground contacts (7) in the form of lugs from the overall housing wall or wall of the second intermediate support (9), respectively, is 90° each.

9. A coaxial high-frequency plug-type connector according to one or several of the claims 1 or 2 or 3 to 8, characterized in that a plurality of overall housings (1) are mounted together on top of each other and/or adjacent each other so as to form a termination connection.

10. A coaxial high-frequency plug-type connector according to one or several of the claims 1, 2, 3, or 8, characterized in that the lugs are formed as part of the overall housing wall or the wall of the second intermediate support (9), respectively.

Fig. 1

Schnitt A-A

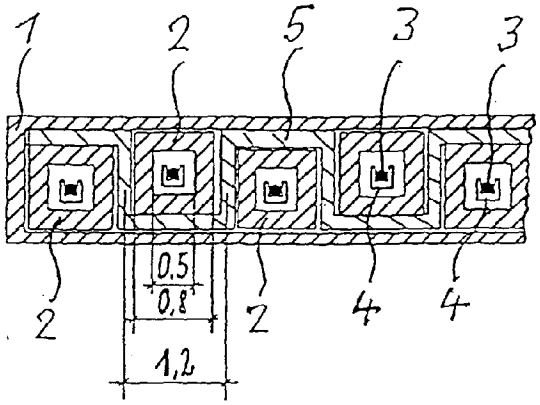


Fig. 2

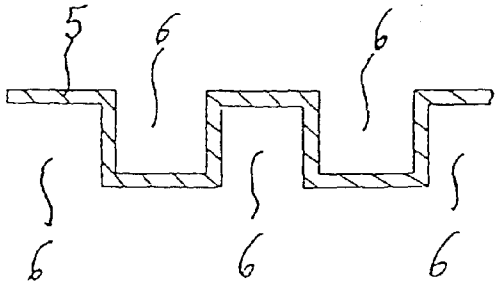
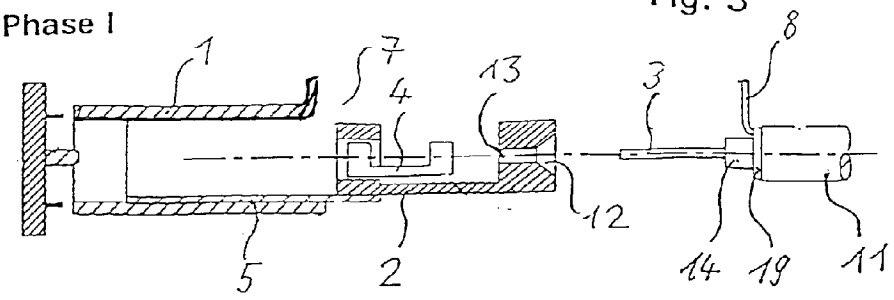


Fig. 3

Phase I



Phase II

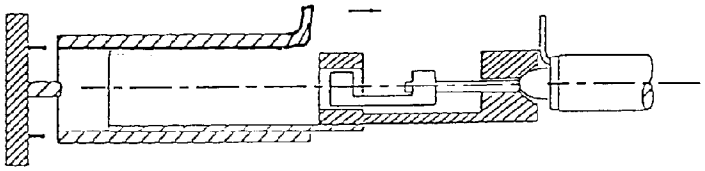


Fig. 4

Phase III

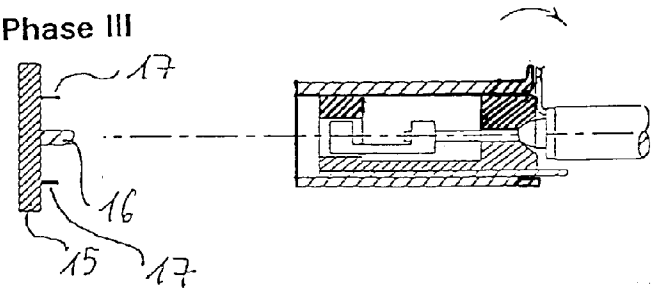


Fig. 5

Phase IV

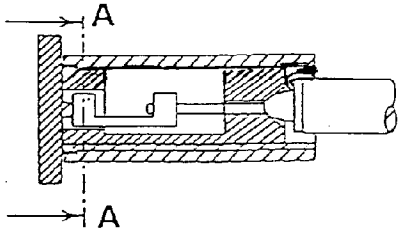


Fig. 6

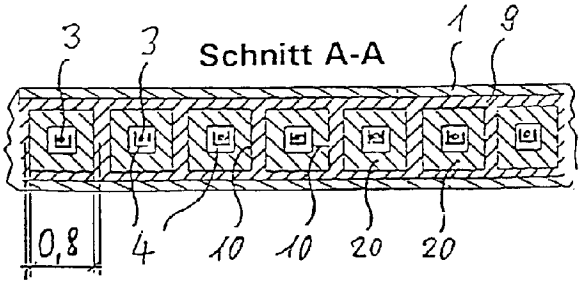
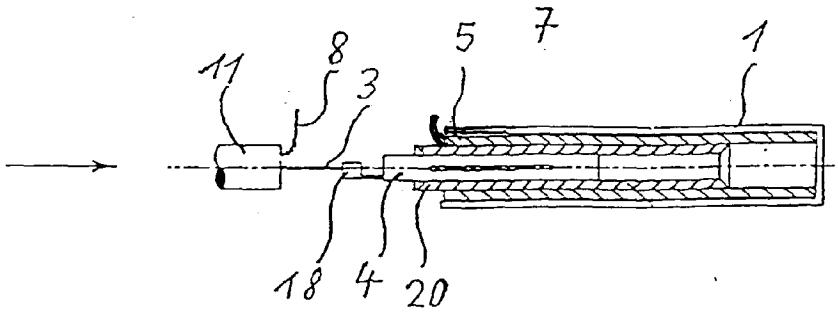


Fig. 7

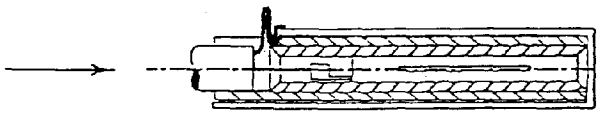
Phase I

Fig. 8



Phase II

Fig. 9



Phase III

Fig. 10